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Geraniums:
Diagnosing Nutrient Disorders

Already this spring, a number of geranium issues have occurred. A quick photographic guide to nutritional disorders may be a useful resource as we begin the zonal geranium (Pelargonium x hortorum) season.

Zonal geraniums are a popular bedding plant for spring sales. They are fairly easy to grow, but a number of disorders are known to occur. This e-GRO Alert is a photographic guide to the most common, and not so common, nutrient disorders of zonal geraniums.

1. Low Substrate pH

When geraniums are being grown in soilless substrate, they prefer a pH of 5.8 to 6.4. When the pH drops below this range, lower leaf symptoms quickly begin to develop. The initial symptoms begin as a chlorotic spotting between the veins, that later advances into interveinal chlorosis and eventually general necrosis (Figs. 1&2).

Iron and manganese toxicity commonly occurs on crops with low pH, leading to the symptoms observed on these plants. A PourThru test for pH may be done to confirm the diagnosis of excessively low pH. A tissue sample of symptomatic foliage may also be submitted to check for elevated levels of iron and manganese.

Figure 1. Low substrate pH induced iron/manganese toxicity with the typical bronzing on the lower leaves.

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Figure 2. Advanced symptoms of low substrate pH induced iron/manganese toxicity on the lower leaves.

Corrective Procedures

When iron and manganese toxicity becomes a problem, raising the pH above 6.0 is best for zonal geraniums. Corrective procedures to raise low pH levels are listed below. Switching to a basic fertilizer when the substrate pH is nearing the lower limit will help stabilize the pH. If the pH is below the recommended range, then corrective procedures will need to be implemented. Flowable lime is one option. Using a rate of 2 quarts per 100 gallons of water will typically increase the substrate pH by roughly 0.5 pH units. Two quarts can be used through an injector. Additional applications can be made if needed. Potassium bicarbonate can also be applied. A rate of 2 pounds per 100 gallons of water will increase the substrate pH by roughly 0.8 pH units. This treatment will also provide excessive potassium and cause a spike in the substrate electrical conductivity (EC). A leaching irrigation with clear water is required the following day to restore the nutrient balance (the ratio of K:Ca:Mg) and lower the EC level. As always, remember to recheck your substrate pH to determine if reapplications are needed.

pH Adjustment Recommendations

Flowable Lime

Use 1 to 2 quarts per 100 gallons of water.

Rinse foliage.

Avoid damage to your injector by using rates of 2 quarts per 100 gallons of water, or less

Can split applications

Hydrated Lime

Mix 1 pound in 3 to 5 gallons of WARM water. Mix twice. Let settle. Decant liquid and apply thru injector at 1:15.

Caustic (rinse foliage ASAP and avoid skin contact)

Potassium Bicarbonate ($KHCO_3$)

Use 2 pounds per 100 gallons of water

Rinse foliage ASAP

Provides 933 ppm K

Leach heavily the following day with a complete fertilizer to reduce EC levels and restore nutrient balance.

Rates greater than 2 pounds per 100 gallon of water can cause phytotoxicity!

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2. Low EC

If the fertilization rate is too low, the lower leaves initially develop a pale green coloration. Over time the lower leaves yellow and then turn necrotic (Fig. 3). On some cultivars, the lower leaves may become red due to the pigments in the leaves (Fig. 4), and phosphorus deficiency could be a mistaken diagnosis. Check the substrate pH and EC to confirm your diagnosis. Target EC levels are between 0.6 and 0.9 mS/cm for the 1:2 method. The recommended SME ranges are between 1.3 and 2.0 mS/cm, while the PourThru range is 2.0 to 3.0 mS/cm.

If low EC problems occur, increase the fertilization rate to 300 ppm N for a few applications before returning to a rate of 150 to 200 ppm N.

Figure 3. Low substrate electrical conductivity (EC) results in lower leaf yellowing.

Figure 4. Red coloration can occur as a result of pigment coloration in the leaves when nitrogen is low.

3. High EC Burn

Too high of a fertilization rate will result in a marginal leaf burn (Fig. 5). Check the substrate EC to confirm your diagnosis. Values greater than 4.0 mS/cm based on the SME method can be problematic. [Target EC levels are between 0.6 and 0.9 mS/cm for the 1:2 method. The recommended SME ranges are between 1.3 and 2.0 mS/cm, while the PourThru range is 2.0 to 3.0 mS/cm.]

To correct the situation, leach the substrate twice with back-to-back clear water irrigations. Then allow the substrate to dry down normally before retesting the EC. If EC levels are still too high, repeat the double leach. Once the substrate EC is back within the normal range, use a balanced fertilizer at the rate of 150 to 200 ppm N.

Figure 5. Marginal leaf burn on the older foliage occurs when the electrical conductivity level is too high.

3. High Substrate pH

The target pH for geraniums is between 5.8 and 6.4. Higher pH values will result in iron deficiency and lead to the development of interveinal chlorosis on the upper leaves (Figs. 6&7). Check the substrate pH to determine if it is too high. Be careful when lowering the substrate pH, because going too low can be much more problematic and difficult to deal with.

Figure 6. When the substrate pH is too high, interveinal chlorosis of the youngest leaves occurs.

4. Magnesium Deficiency

In order to avoid low pH problems, higher amounts of lime may be used in the substrate. If the lime provides excessive levels of calcium, it can induce a deficiency of magnesium. These two elements have an antagonistic relation between each other. Magnesium deficiency develops on the lower foliage as an interveinal chlorosis (Fig. 8). A close up of symptoms of interveinal chlorosis can be seen on this geranium leaf (Fig. 9). Symptoms may appear similar to low pH, but magnesium deficient plants lack the bronze speckling that is typically associated with a low pH problem. Even so, it is beneficial to check the substrate pH to ensure low pH is not the issue. A substrate test that measures all the nutrients and/or a tissue sample will help confirm a magnesium deficiency. To correct the issue, mix 2 pounds of Epsom salts per 100 gallons of water and apply it to the substrate as a drench with 10% leaching fraction.

Figure 7. Advanced symptoms of elevated substrate pH results in interveinal chlorosis of the top growth.

Hopefully this guide will help in the diagnosis of nutritional disorders of geraniums, and aid you to producing a healthy and successful crop.

Figure 8. Excess limestone applications leads to elevated calcium levels which out compete magnesium.

Figure 9. Close up of interveinal chlorosis of the lower leaves which occurs when magnesium is deficient.

What causes white spotting on geraniums leaves? Is it a nutrient problem? Or could it be spray burn? No, it is caused by *Botrytis*. The spores attack the leaf but fail to get established. This results in the white spotting. It is typically observed after a period of cloudy, damp weather.